STRUCTURE FOR A PASSENGER MOTOR VEHICLE AND METHOD OF MAKING SAME

[0001] This application claims the priority of German Application No. 102 29 401.1 filed on June 29, 2002, the disclosure of which is expressly incorporated by reference herein.

[0002] The invention concerns a structure for a vehicle, specifically a passenger motor vehicle comprising a panel structure made of non-metallic material, such as fiber reinforced plastic.

[0003] A prior single-axle vehicle described in PCT Publication WO 96/00667 (corresponding U.S. Patent 5,653,494), has been designed as a lightweight trailer comprising of a base frame carried by wheels and essentially made of non-metallic material. A vehicle body structure, based on hollow longitudinal girders, is made of similar material.

[0004] European Patent Document No. EP 0 286 058 A2 deals with a self-supporting structural element of composite material for a vehicle structure that is formed by a panel unit. The panel unit includes a transition piece that is bordered by surface layers. This structural element produces a good strength-to-weight ratio.

[0005] U.S. Patent 3,145,000 represents a high-strength fiberglass reinforced component for an aircraft wing, which is provided with a panel section that contains a core, e.g. of honeycomb structure, embedded in deck panels.

[0006] It is a purpose of the invention to design a structure for a vehicle, specifically a passenger motor vehicle, that is made of non-metallic material while offering high strength and light weight, and distinguishing itself by its functional performance.

[0007] The present invention meets said purpose by providing a structure for a passenger motor vehicle, comprising a panel structure made of non-metallic material, such as fiber-reinforced plastic, wherein the structure forms a passenger cell, of which the panel structure comprises a front panel structure, a rear panel structure, a floor structure joining the front and rear panel structures, and longitudinal girders that extend between the panel structures and border the floor structure. Additional invention feature details are included in the description and the claims. The invention offers major advantages in that the structure formed by a passenger cell is optimized with regard to lower weight and high strength by its consistence of high-strength non-metallic material, e.g. fiberglass reinforced plastic, preferably CFRP (Carbon Fiber Reinforced Plastics). A front panel structure, a rear panel structure, a floor structure, longitudinal girders and a center tunnel are integrated in the passenger cell, resulting in functional performance, i.e. the passenger cell offers adequate space to passengers, and additional body sections of the passenger motor vehicle, such as front and rear end, can easily be attached.

[0008] Mounted above the front panel structure is e.g. a non-metallic, but high-strength windshield frame, provided with flanges. These flanges hold the windshield frame to the first panel section and the second panel section of the front panel structure by means of adhesive bonding. Inside the hollow spaces of the windshield frame columns, support columns that are connected with the front panel structure are provided. These support columns, combined with the columns of the windshield frame, contribute to passenger safety. Retainer plates that are joined to the metal support columns serve as connectors. These retainer plates are supported by the front panel structure and are bolted to said panel structure.

[0009] Furthermore, the passenger cell rear panel structure and e.g. a non-metallic roll bar mounting are structurally joined, resulting in structural and spatial clarity as well as optimizing the roll bar safety function. Additionally, the use of non-metallic materials, preferably composite materials – CFRP –, for the passenger cell and the roll bar mounting, as well as their connection, facilitates production. Finally, there is the option to replace the roll bar mounting by two single roll bars in the area of the passenger seats, creating a compact concept that leaves room for free design.

[0010] Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is a view from above of a passenger motor vehicle with a structure according to a preferred embodiment of the invention;

[0012] Figure 2 is an angular view from above of the passenger motor vehicle structure of Figure 1;

[0013] Figure 3 is a large-scale schematic cross section along line III-III of Figure 1;

[0014] Figure 4 is a cross sectional view along line IV-IV of Figure 3;

[0015] Figure 5 is a cross sectional view along line V-V of Figure 3;

[0016] Figure 6 is a large-scale cross section along line VI-VI of Figure 1;

[0017] Figure 7 is an angular view of a windshield frame column of the structure of Figure 1;

[0018] Figure 8 is a cross sectional view along line VIII-VIII of Figure 6; and

[0019] Figure 9 is a cross sectional view along line IX-IX of Figure 1.

DETAILED DESCRIPTION OF THE DRAWINGS

[0020] Note that the structure shown to the right of the line/plane identified by reference character 71 in Figures 1 and 2 is included to show the environment of the vehicle body structure of preferred embodiments of the present invention and is therefore not further described in detail herein, except for designation of the battery accommodating space 32.

[0021] Of a passenger motor vehicle 1 with an open body, essentially only one vehicle body structure 2 is depicted, which comprises a structure 3. Structure 3 comprises a passenger cell 4 with a passenger compartment 5, with housings 6 and 7 for two side by side passenger seats 8 and 9. The passenger cell 4 is made of high-strength non-metallic material, e.g. fiber-reinforced plastic – composite CFRP –, and includes a panel structure 10 with a front panel structure 11 and a rear panel structure 12, attached to a floor structure 13. The floor structure 13 is bordered on the longitudinal sides 14, 15, by cross-sectional box-shaped side members 16, 17, extending between panel structures 11 and 12, and the floor structure 13 contains a center tunnel 18, which runs between the front panel structure 11 and the rear panel structure 12; the side members 16, 17, and the center tunnel 18 extend in longitudinal vehicle direction A-A.

[0022] The front panel structure 11 (Figure 3) contains a first panel section 20, which extends from a first floor section 19 of the floor section 13 in vertical vehicle direction B-B and borders a nose compartment 21. A second panel section 23 extends from a top end 22 of the first panel section 20 in facing opposite driving direction C. The first floor section 19, the first panel

section 21, and the second panel section 23 border a leg compartment 24 of passenger cell 4. Furthermore, the first floor section 19 of the floor structure 13 in the area of the leg compartment 24 is provided with a local thickening 25, which serves as a base for pedals (not shown).

[0023] The rear panel structure 12 contains a third panel section 27, which extends from a rear floor section 26 of the floor section 13 in generally vertical vehicle direction B-B. A fourth panel section 29 is attached to the top end 28 of the third panel section 27 and is aligned in facing opposite driving direction C. The rear floor section 26, the third panel section 27, and the fourth panel section 29 border a cavity 30 with an open side 31, which extends toward a battery space 32. The cavity 30 is designed to accommodate a tank 33 for passenger vehicle fuel and can be closed on the open side 31 by means of an upright panel 34.

[0024] According to Figure 6, the front panel structure 11 and e.g. a non-metallic windshield frame 35 are structurally joined; like the remaining structure 3, or the passenger cell, the windshield frame 35 can be made of high-strength fiber-reinforced plastic – CFRP –, as described in EP 0 286 058 A1. With this, the windshield frame is designed as a hollow member, comprising a bearing panel 37 for a windshield 38. This bearing panel 37 is provided with support panels 38, 38', of which the free ends 40, 41 are provided with flanges 42, 43. The flanges 43, 44 extend to the first panel section 20 and the second panel section 21, and are held in position by adhesive bonding 45, 46. For a flush seat of flange 43 on the second panel section 23, the latter is provided with a recess 47.

[0025] The windshield frame 35 has upright columns 48, 49, so-called A-pillars, that are provided with hollow spaces 50, 51, containing support columns 52 (Figure 7). Each support column 52 is made of metal and is attached to the front panel structure 11. The support column 52 is held in

position on said panel structure by means of a retainer plate 53. The retainer plate 53 has legs 54, 55 that extend toward each other at an angle. The legs 54, 55 are based on corresponding panel areas 56, 57 of the front panel structure 11, and the retainer plate 53 is fixed by bolts 58, that are aligned with tap holes 59 of a metallic insert 60. The insert 60 with the legs 62, 63 is integrated in the front panel structure 11 in such manner that this insert 60 is covered by contact panels 65, 66, which enclose a core 66 outside the insert 60; this design is described in the above mentioned EP 0 286 058 A1. Between support column 52 and column 48 is foam material 67, which only extends across a relatively small section Tb of a free end 68 of the support column 52. Furthermore, the support column 52 consists of a minimum of two sleeved tubes 69, 70, which, in the embodiment shown, have a circular cross section.

[0026] A roll bar mounting 71 is structurally joined with the rear panel structure 12. The roll bar mounting 71 is made of non-metallic material, preferably fiber composite material, such as CFRP. The roll bar mounting 71 consists of two single roll bars 72, 73, which are attached to the rear panel structure 12 in the area of the housings 6, 7 for the passenger seats 8, 9. In a cross-sectional view, each single roll bar, e.g. 72, comprises upright side panels 74, 75 that are spaced in longitudinal vehicle direction A-A and between which a connecting panel 76 extends. The side panels 74, 75 reach the rear panel structure 12 with free ends 77,78, and rest in recesses 79, 80 of said panel structure 12 by means of adhesive bonding 81, 82. The connecting panel 76 is designed for bearing a roof and has a groove 83 for a seal. The seal lies between the single roll bar 72 and the roof. Finally, Figure 2 illustrates that the front wall structure 12 is supported on the center tunnel 18 with a support strut 84, which extends in longitudinal vehicle direction A-A and takes a rising course in driving direction C. The support strut 84 is attached

to the center tunnel 18 or the front panel structure 12 with bolts, adhesives or the like.

[0027] The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.